1. PURPOSE. This change deletes the TERPS requirement for middle markers for precision ILS approaches, thereby, removing the 50-foot penalty for all users of this instrument landing system.

2. DISPOSITION OF TRANSMITTAL: Retain this page after changed pages have been filed.

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x	7/26/90	x	9/10/93
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Figure 27.

278. END OF MISSED APPROACH. Aircraft shall be assumed to be in the initial approach or en route environment upon reaching minimum obstacle clearance altitude (MOCA) or minimum en route altitude (MEA). Thereafter, the initial approach or the en route clearance criteria apply.

279. RESERVED.

Section 8. Terminal Area Fixes

280. GENERAL. Terminal area fixes include, but are not limited to the Final Approach Fix (FAF), the Intermediate Fix (IF), the Initial Approach Fix (IAF), the holding fix, and when possible, a fix to mark the missed approach point. Each fix is a geographical position on a defined course. Terminal area fixes should be based on similar navigation systems. For example, TACAN, VORTAC, and VOR/DME facilities provide Radial/DME fixes. NDB facilities provide bearings. VOR facilities provide VOR radial. The use of integrated (VHF/NDB) fixes shall be limited to those intersection fixes where no satisfactory alternative exists.

281. FIXES FORMED BY INTERSECTION. A geographical position can be determined by the intersection of course or radials from two stations. One station provides the course the aircraft if flying and the other provides a crossing indication which identifies a point along the course which is being flown. Because all stations have accuracy limitations, the geographical point which is identified is not precise, but may be anywhere within a quadrangle which surrounds the plotted point of intersection. Figure 28 illustrates the intersection of an arc and a radial from the same DME facility and the intersection of two radials or courses from different navigation facilities. The area encompassed by the sides of the quadrangle fromed in these ways is referred to in this publication as the "fix displacement area."

divergence between the signal sources at the fix does not exceed 23°. See Figure 28. For limitation on use of DME with ILS, see paragraph 912.

* **283. FIXES FORMED BY RADAR.** Where ATC can provide the service, Airport Surveillance Radar (ASR) may be used for any terminal area fix. Precision Approach Radar (PAR) may be used to form any fix within the radar coverage of the PAR system. Air Route Surveillance Radar (ARSR) may be used for initial approach and intermediate approach fixes. *

284. FIX DISPLACEMENT AREA. The areas protrayed in Figure 28 extend along the flight course from point "A" to point "C". The fix error is a plus-or-minus value, and is represented by the lengths from "A" to "B" and "B" to "C". Each of these lengths is applied differently. The fix error may cause the fix to be received early (between "B" and "C"). Because the fix may be received early, protection against obstacles must be provided from a line perpendicular to the flight course at point "A".

285. INTERSECTION FIX DISPLACEMENT FACTORS. The intersection fix displacement area is determined by the system use accuracy of the navigation fixing systems. The system use accuracy in VOR and TACAN type systems is determined by the combination of ground station error, airborne receiving system error, and pilotage error. Long experience in en route use of VOR has shown that a VOR system use accuracy along radial courses of plus-or-minus 4.5°, 95% of occasions, is a realistic, conservative figure. Thus, in normal use of VOR or TACAN intersections, fix displacement factors may conservatively by assessed as follows:

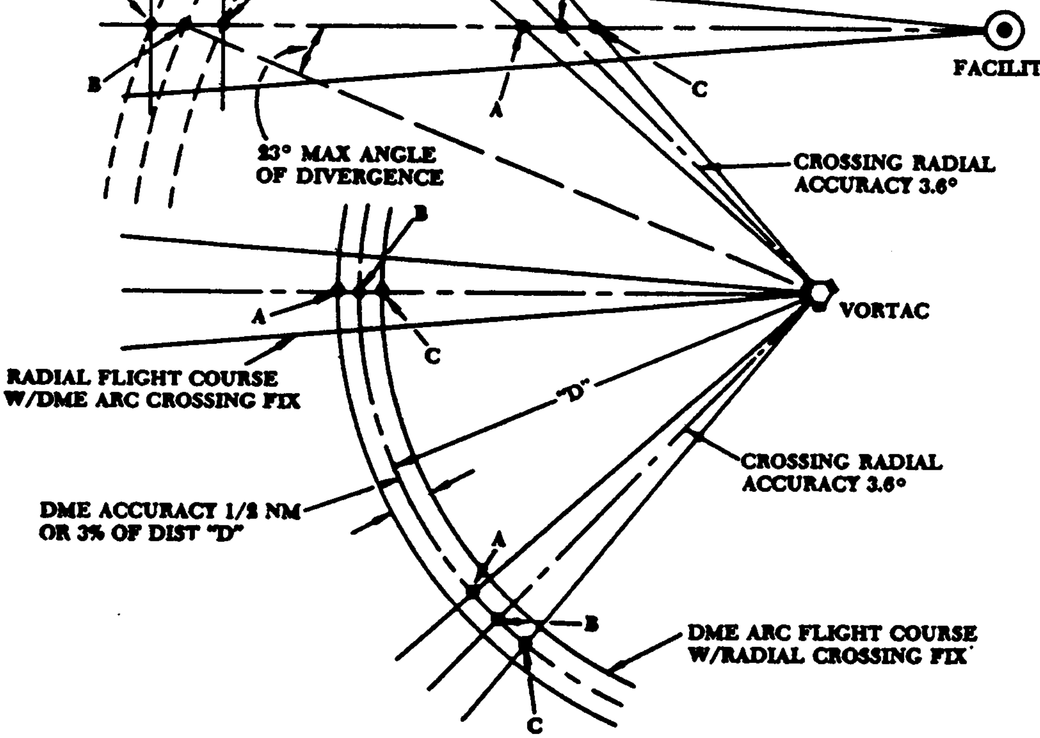


Figure 28. INTERSECTION FIX DISPLACEMENT. Par 281, 282, 283.

a. *Along-Course Accuracy.*

(1) VOR/TACAN radials, plus-or-minus 4.5 degrees.

(2) Localizer course, plus-or-minus 1 degree.

* (3) NDB courses or bearing, plus-or-minus 5 degrees. *

NOTE: *The plus-or-minus 4.5-degree (95 percent)* VOR/TACAN figure is achieved when the ground station course signal error, the pilotage error, and the VOR airborne equipment error are controlled to certain normal tolerances. Where it can be shown that any of the three error elements is consistently different from these assumptions (for example, if flight inspection shows a consistently better VOR signal accuracy or stability than the one assumed, or if it can be shown that airborne equipment error is consistently smaller than assumed), VOR fix displacement factors smaller than those shown above may be utilized in accordance with paragraph 141.

	APPROACH LIGHT CONFIGURATION	CAT →	A – B – C		D	
		HAT[1]	Vis or RVR		Vis or RVR	
1	NO LIGHTS	250	1	5000	1	5000
2	ODALS	250	¾	4000	1	5000
3	MALS	250	¾	4000	1	5000
4	SSALS/SALS	250	¾	4000	1	5000
5	MALSR	250	½[2]	2400	1[3]	5000
6	SSALR	250	½[2]	2400	1[3]	5000
7	ALSF-1	250	½[2]	2400	1[3]	5000
8	DME Arc Any Light Configuration	500	1	5000	1	5000

[1]Add 50 ft to HAT for VOR without FAF or NDB with FAF.
Add 100 ft to HAT for NDB without FAF.

[2]For NDB approaches, ¾ mile or RVR 4000.

[3]For LOC, ¾ mile or RVR 4000.

*

	PRECISION APPROACHES					
	Approach Facility: ILS[4] or PAR					
	APPROACH LIGHT CONFIGURATION	CAT →	A – B – C		D	
		HAT	Vis or RVR		Vis or RVR	
9	NO LIGHTS	200	¾	4000	¾	4000
10	MALSR	200	½	2400	½	2400
11	SSALR	200	½	2400	½	2400
12	ALSF-1	200	½	2400	½	2400
13	ALSF-1-TDZ/CL MALSR-TDZ/CL SSALR-TDZ/CL	200	-	1800	-	1800

[4]ILS includes LOC, GS, and OM(or FAF). With Offset LOC(max 3°), HAT is 250 and RVR below 2400 is not authorized. *

NOTE: HIRL is required for RVR. Runway edge lights required for night.

200	C,D,E	3/4	40	1/2 [2]	24 [2]	1/2 [2]	24 [2]	1/2 [2]	24 [2]	3/4	40	1/2 [2]	24 [2]	3/4	40	3/4	40
250	A–B	3/4 [4]	40 [4]	1/2	24	1/2 [3]	24 [3]	1/2	24	3/4	40	1/2	24	3/4	40	3/4	40
250	C,D,E	1	50	1/2	24	1/2 [3]	24 [3]	1/2	24	3/4	40	1/2	24	3/4	40	1	50
NON–PRECISION																	
AS REQUIRED	A–B	1	50	1/2	24	1/2	24	1/2	24	3/4	40	1/2	24	3/4	40	3/4	40
AS REQUIRED	C,D,E	1	50	3/4	40	3/4	40	3/4	40	3/4	40	3/4	40	3/4	40	3/4	40
DME ARC APPROACH																	
AS REQUIRED	A–E	1	50	(REDUCTION BELOW ONE MILE NOT AUTHORIZED)													

[1] RVR shown in hundreds of feet, i.e. RVR 24=2400ft.

[2] Minimum length of approach lights is 2000 feet.

[3] For non–standard ALS lengths of:
a. 2400 to 2900 feet, use SSALR.
b. 1000 to 2300 feet, use SSALS.

[4] When the MAP is located 3/4 mile or less from the threshold.

INSTRUCTIONS FOR ESTABLISHING MILITARY STRAIGHT–IN MINIMUMS
(Use Table 10)

STEP 1.	Determine the required DH or MDA by applying criteria found in the appropriate facility chapter of this Handbook.
STEP 2.	Determine the height above touchdown zone elevation (HAT).
STEP 3.	Determine the visibility value as follows: a. Precision Approaches. (1) HAT 250 feet or less. Enter "precision" portion of Table 10 at HAT value for aircraft approach category. Read across table to determine minimum visibility for the appropriate light system. If the HAT is not shown on the table, use the next higher HAT. (2) HAT greater than 250 feet. Use the instructions for the non–precision minimums in. b. below Paragraph 331 does not apply. b. Non–Precision Approaches. Determine the basic visibility by application of criteria in paragraphs 330 and 331. If the basic visibility is 1 mile, enter Table 10 with aircraft approach category being considered. Read across the table to determine minimum visibility for the appropriate light system.
STEP 4.	Establish ceiling values in 100–foot increments in accordance with paragraph 310.

901. DEFINITION OF TYPES.

a. ILS Category I. An ILS approach procedure which provides for approach to a decision height of not less than 200 feet.

b. ILS Category II. See Section 6. Criteria to be incorporated at a later date.

c. ILS Category III. See Section 7. Criteria to be incorporated at a later date.

d. Localizer and LDA. Approach procedures which do not use the glide slope component of the ILS.

e. Simultaneous ILS. An ILS approach procedure based on ILS installations which serve parallel runways and provides for simultaneous approaches to authorized minimums.

902.-909. RESERVED.

Section 1. ILS Category I Components

* **910. SYSTEM COMPONENTS.** The Category I ILS procedures are based upon the components listed below. Substitution is permitted only as specified in Paragraphs 283, 911, 912, and 930.

a. Localizer (LOC), Category I quality or better.

b. Glide Slope (GS), Category I quality or better.

c. Outer Marker (OM). *

* **911. COMPASS LOCATOR (LOM).** Compass locator radio facilities may be installed at outer marker sites, but are not considered basic components of the ILS. However, when installed, they may be used in lieu of the outer marker. *

derived from a separate facility, as specified in Paragraph 282, may also be used to provide ARC initial approaches, a FAF for back course (BC) approaches, or as a substitute for the outer marker. When used as a substitute for the outer marker, the fix displacement error shall NOT exceed plus or minue 1/2 mile and the angular divergence of the signal sources shall NOT exceed 6 degrees.

913. INOPERATIVE COMPONENTS. A complete Category I ILS consists of the components specified in Paragraph 910. When the localizer fails, an ILS approach is not authorized. When the glide slope becomes inoperative or is not available, the ILS reverts to a nonprecision approach system. In this case, obstacle clearance from Paragraph 954 and the nonprecision minimums from Paragraph 350 apply. * When other components become inoperative, the ILS may continue in use with the landing minimums as prescribed in Paragraph 350. *

914.-919. RESERVED.

Section 2. ILS Category I Criteria

920. FEEDER ROUTES. The criteria for feeder routes are contained in Chapter 2, Section 2.

921. INITIAL APPROACH SEGMENT. The criteria for the initial approach segment are contained in Chapter 2, Section 3. Procedrue turns shall be specified from the outer marker wherever practical.

point for ILS approaches. The minimum length of the intermediate segment depends on the angle at which the initial approach course intersects the localizer course, and is specified in table 18. The MAXIMUM angle of intersection shall be 90 degrees, unless a lead radial, as specified in paragraph 232a, is provided and the length of the intermediate segment is increased in accordance with paragraph 242b. See figure 75.

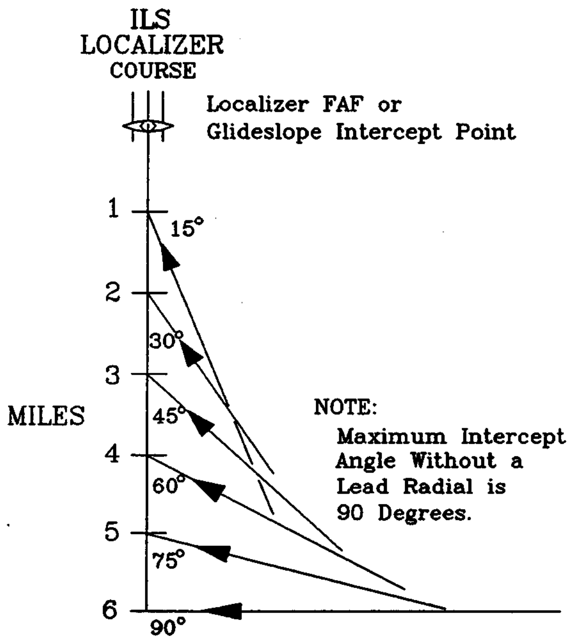


Figure 75. INTERMEDIATE SEGMENT vs. ANGLE OF INTERSECTION. ILS Category I. Par. 922.

923. DESCENT GRADIENT. Even though the minimum length of the intermediate segment may be less than that specified in chapter 2, section 4, intermediate descent criteria specified in paragraphs 242d and 243d shall be applied to at least 5 miles of flight track immediately prior to the glide slope intercept point.

30	2
45	3
60	4
75	5
90–96	6

924. ALTITUDE SELECTION. Altitudes selected for the initial approach and intermediate approach segments shall be established and provide required obstacle clearance as specified in chapter 2. In addition, the selected altitudes shall be limited as follows:

a. Procedure Turn. The procedure turn completion altitude shall NOT be lower than the glide slope interception altitude nor more than 500 feet above the glide slope interception altitude. The glide slope interception point shall be the outer marker whenever possible.

b. High Altitude Teardrop Penetration Turn. The penetration turn completion altitude shall NOT be lower than the glide slope interception altitude nor more than 4000 feet above the glide slope interception altitude. The glide slope interception point shall be the outer marker whenever possible.

c. Other Initial Approaches. The altitude at which the localizer course is intercepted shall NOT be less than the glide slope interception altitude.

d. Intermediate Approach. The altitude shall NOT be less than the glide slope interception altitude. The glide slope interception point shall be the outer marker whenever possible. When the glide slope is inoperative, the intermediate approach altitude shall provide at least 500 feet of obstacle clearance from the point of interception of the localizer course to the outer marker or other final approach fix. The altitudes selected by application of the obstacle clearance specified in this paragraph may be rounded to the nearest 100 feet. See paragraph 231.

925.-929. RESERVED.

paragraph 287 for satisfactory fix.) At locations where it is not possible for the point of glide slope intercept to coincide with a designated FAF, the point of glide slope interception shall be located PRIOR to the FAF. Where a designated FAF cannot be provided, specific authorization by the approving authority is required. *

a. Alignment. The final approach course is normally aligned with the runway centerline. Where a unique operational requirement indicates a need for an offset course, it may be approved, provided the course intersects the runway centerline at a point 1,100 to 1,200 feet toward the runway threshold from the DH point on the glide flope and the angular divergence of the course does NOT exceed 3 degrees.

b. Area. The area considered for obstacle clearance in the final approach segment consists of a final approach area and transitional surfaces.

(1) Final Approach Area. The final approach area has the following dimensions:

(a) Length. The final approach area is 50,000 feet long measured outward along the final approach course from a point beginning 200 feet outward from the runway threshold. Where operationally required by other procedural considerations due to existing obstacles, the length may be increased al shown in Figure 76. The final approach area used shall only be that portion of the area which is between the glide slope interception point and the point 200 feet from the threshold.

(b) Width. The final approach area is centered on the extended runway centerline except in those cases where an offset localizer is required, as provided in paragraph 930a, in which case the area is centered on the final approach course. The area has a width of 1,000 feet at the point 200 feet from the threshold and expands uniformly to a width of 16,000 feet at a point 50,000 feet from the point of beginning. This width further expands uniformly where greater length is required as in paragraph 930b(1)(a). See

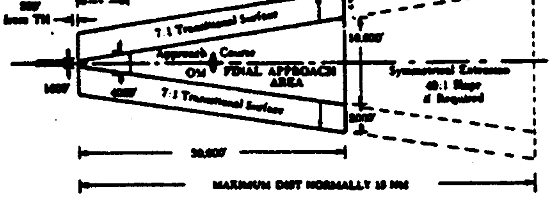


Figure 76. ILS CATEGORY I FINAL APPROACH AREA.
Par 930

The width either side of the centerline at a given distance "D" from the point of beginning can be found by using the formula "500+.15D=1/2W"; e.g.; 500+.15x50,000=8,000, which is 1/2 width; therefore, the total width is 16,000 feet at the 50,000 foot point.

NOTE: *Where glide slope interception occurs at a distance greater than 50,200 feet from the threshold, the final approach area and the final approach surface may be extended symmetrically to a maximum distance dictated by the usability of the glide slope.*

931. FINAL APPROACH OBSTACLE CLEARANCE SURFACE. The final approach obstacle surface is an inclined plane which originates at the runway threshold elevation 975 feet outward from the GPI, and which overlies the final approach area. The surface is divided into two sections: an inner 10,000-foot section and an outer 40,000-foot section. The slope of the surface changes at the 10,000-foot point. The exact gradient may differ according to the angle at which the glide slope is established. The 50:1 and 40:1 slopes which are applicable to the 2 1/2-degree glide slope shall be established unless other slopes must be used to assure required clearance over existing obstacles. Table 19 specifies slopes which provide the minimum required obstacle clearance for several glide slope angles. See also paragraphs 934 and 935.

932. TRANSITIONAL SURFACES. Transitional surfaces for ILS Category I are inclined planes with a slope of 7:1 which extend outward and upward from the edge of the final approach area, starting at the height of

2 1/2	50:1	40:1
2 3/4	40.5:1	34:1
3	34:1	29.5:1

NOTE: See graph, Appendix 2, Figure 132 for interpolation.

the applicable final approach surface and extending for a lateral distance of 5,000 feet at right angles to the final approach point. See figure 76.

933. DELETED.

934. OBSTACLE CLEARANCE OUTSIDE THE DH POINT. No obstacle shall penetrate the applicable final approach obstacle clearance surface specified in paragraph 931 or the transitional surfaces specified in paragraph 932. The required obstacle clearance is based on the difference between the glide slope angle and the appropriate final approach surface specified in paragraph 931. To determine the minimum required obstacle clearance in feet for any given distance "D" from the GPI, the following formulas may be used:

For "D" less than 10,975 feet, the minimum required clearance is .02366 D + 20 feet. See paragraph 935.

For "D" 10,975 feet or more, the minimum required clearance is .01866 D + 75 feet.

The clearance provided by these formulas is a minimum requirement. Greater clearance may be necessary in the interest of safety, due to such factors as precipitous terrain or ILS installation peculiarities. The Nomograph in Figure 77 provides a simple method for determining the minimum obstacle clearance requirements. Included in Figure 77 is also an example for determing the required glide slope angle. See also paragraph 935.

point. When penetration of this surface exists, consideration should be given to the removal of the obstacle or relocation of the landing threshold. See Figure 131. *

936. GLIDE SLOPE. In addition to the required obstacle clearance, the following shall apply to the selection of glide slope angle and antenna location:

a. Glide Slope Angle.

(1) Civil ILS Facilities. All new and relocated ILS facilities will be commissioned with a 3° glide slope angle. Existing facilities may continue in operation without change in the established glide slope angle. Angles over 3° shall not be established without Office of Flight Operations, FAA, Washington, D.C., approval.

(2) Military ILS Facilities. The optimum glide slope angle is 2 1/2°. Angles less than 2° or more than 3° shall not be established without the authorization of the approving authority.

NOTE. *Where PAR serves a runway that is also served by ILS and/or VASI, the PAR, ILS, and VASI glide slope angles and RPI shall coincide. The PAR glide slope angle shall be within 0.20 of the ILS/VASI glide slope angle and the RPI shall be within plus or minue 50 feet of the ILS/RPI and/or VASI runway reference point (RRP).*

b. Glide Slope Threshold Crossing Height. The OPTIMUM threshold crossing height is 50 feet. The MAXIMUM is 60 feet. A height as low as 32 feet for military airports may be used at locations where special consideration of the glide path angle and antenna location are required. Where the glide slope threshold crossing height exceeds 60 feet, consideration shall be given to the relocation of the landing threshold to insure effective placement of the approach light system. See Appendix 2 for a method of computing threshold crossing height.

intercepts the final approach course. It extends along the inbound course to the glideslope intercept point.

996. FINAL APPROACH SEGMENT. Criteria for the final approach segment are contained in section 3 of this chapter.

997. FINAL APPROACH COURSE STANDARDS. The final approach courses for simultaneous ILS approaches require the following:

a. Dual approaches shall have a minimum of 4,300 feet separation between parallel final approach courses.

b. Triple approaches shall have a minimum of 5,000 feet separation between parallel final approach courses. For triple parallel approach operations at airport elevations above 1000 feet MSL, airport surveillance radar with high resolution final monitor aids or high update radar with associated final monitor aids shall be required.

c. No Transgression Zone (NTZ). The NTZ shall be 2,000 feet wide equidistant between final approach courses.

d. Normal Operating Zone (NOZ). The area between the final approach course and the NTZ is half of the normal operating zone.

(1) The NOZ for dual simultaneous ILS approaches shall not be less than 1,150 feet in width each side of the final approach course. See figure 97A.

(2) The NOZ for triple simultaneous ILS approaches shall not be less than 1,500 feet in width each side of the final approach course. See figure 97B.

998. MISSED APPROACH SEGMENT. Except as stated in this paragraph, the criteria for missed approach are contained in section 4 of this chapter. A missed approach shall be established for each of the simultaneous systems. The minimum altitude specified for commencing a turn on a climb straight ahead for a missed approach shall not be less than 400 feet above the TDZE.

500 feet above the TDZ elevation for that runway.

999. RESERVED.

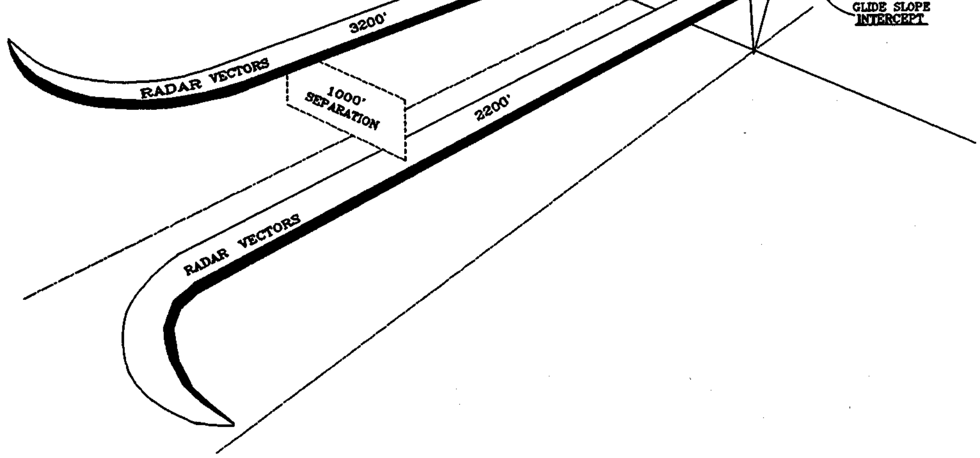


Figure 96A. INITIAL APPROACH SEGMENT, SIMULTANEOUS ILS. Par 994.

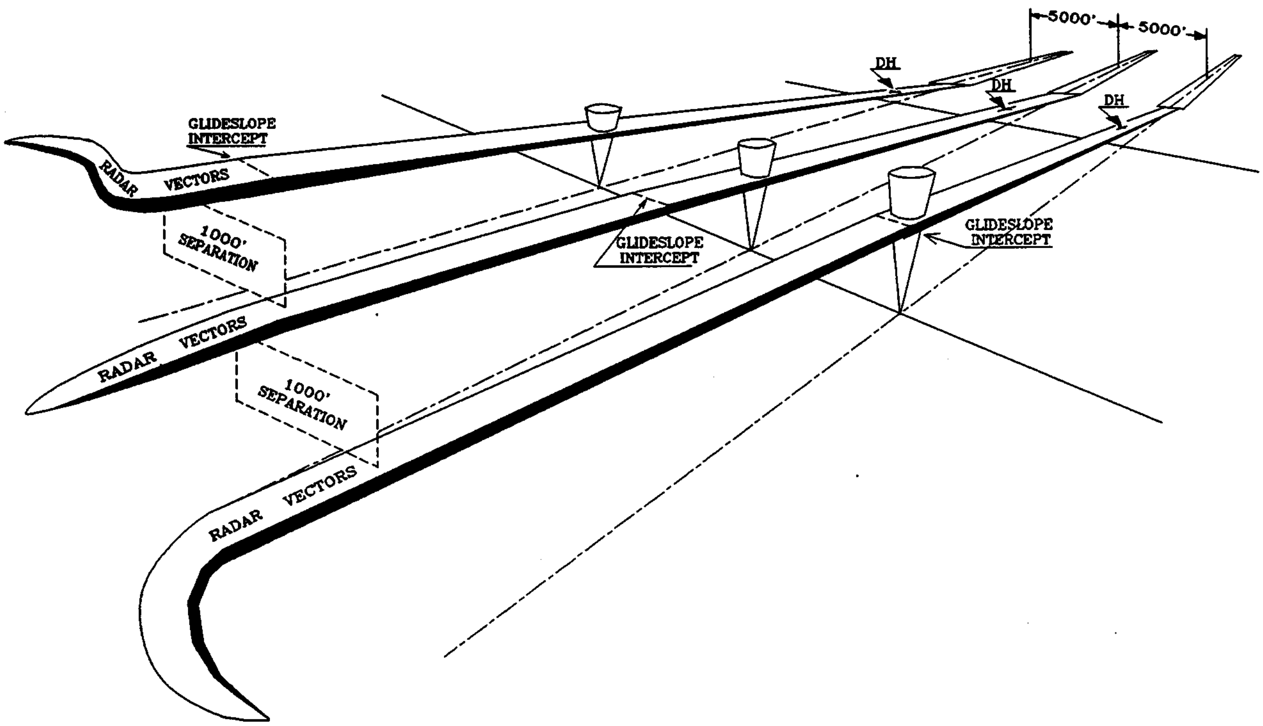


Figure 96B. INITIAL APPROACH SEGMENT FOR TRIPLE SIMULTANEOUS ILS. Par 994.

*

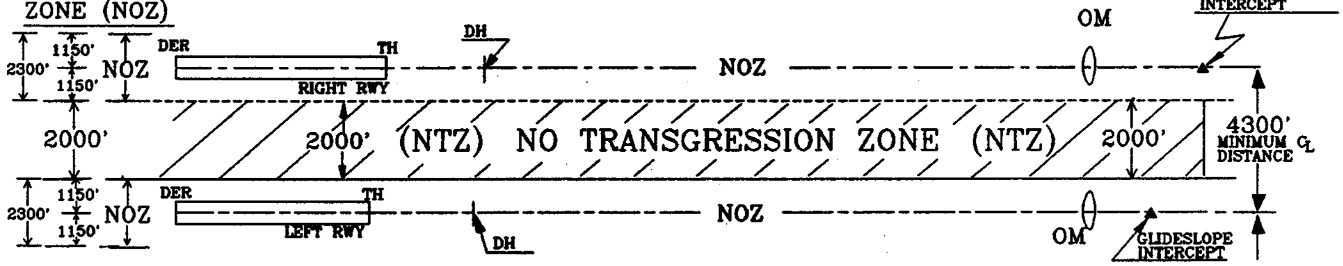


Figure 97A. DUAL SIMULTANEOUS ILS "NO TRANSGRESSION AND NORMAL OPERATING ZONES." Par 997.

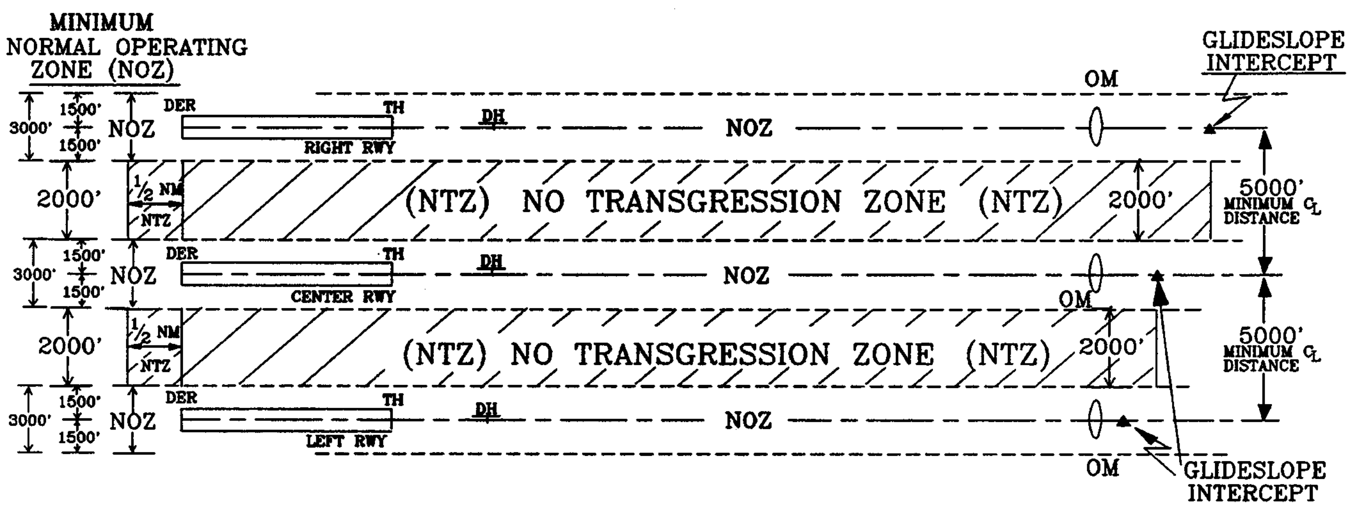


Figure 97B. TRIPLE SIMULTANEOUS ILS "NO TRANSGRESSION AND NORMAL OPERATING ZONES." Par 997.

*

may be found if two are known.

(1) Example. With GS angle 2.6 degrees and TCH 48 feet, D_1 is 1057 feet.

(2) Example. With the same TCH, but a GS angle of 2.7 degrees, D_1 is 1017 feet.

(3) Example. D_1 is 1000 feet. For the optimum 50-foot TCH, the GS angle is 2.86 degrees.

(4) Example. GS angle is 2.7 degrees, and D_1 is 1050 feet. TCH is 49.5 feet.

10. COMPUTATION OF GPI WHEN TCH IS KNOWN. The GPI will be located abeam the glide slope antenna only when the terrain in the vicinity of the runway is perfectly flat. When the terrain slopes significantly between the runway threshold and the GS antenna location, the GPI will not be located abeam the GS antenna. This is because the GPI is the point at which the straight line extension of the glide slope intersects the approach surface base line (ASB). The ASB has the same elevation as the runway threshold. Therefore, the GPI will always be the same distance from the threshold when TCH and GS angles are the same. See figures 129, 129A, and 129B.

11. APPLICATION OF ILS/PAR OBSTACLE CLEARANCE CRITERIA. The Required Obstacle Clearance (ROC) may be defined as the minimum vertical separation between the glide slope and the final approach obstacle clearance surface. Since obstacle clearance requirements change in the final approach area, it has been segmented (paragraph b, below) for ease of application into "Zones 1, 2, and 3" for determining the appropriate obstacle clearance requirements. See figure 131.

(2) Approach Surface Baseline. An imaginary horizontal line at the threshold elevation.

(3) Final Approach Obstacle Clearance Surface. An inclined plane which originates at the runway landing threshold elevation, and;

(a) In Zone 1: 200 feet out from the landing threshold.

(b) In Zones 2 and 3: 975 feet outward from the GPI.

(4) "d" - Distance from the GS antenna to the threshold.

(5) "D" - Distance from the GPI to an obstacle.

(6) "D_1" - Distance from the GPI to the threshold.

(7) "D(t)" - Distance from the threshold to an obstacle minus 200 feet.

(8) "S(i)" - Slope of inner section approach surface.

b. Final Approach Critical Zones. See figure 131.

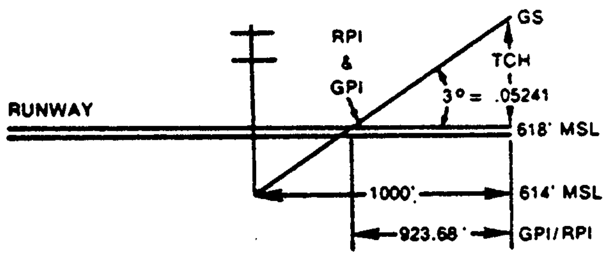
(1) Zone 1. This zone starts at a point 200 feet * outward from the landing threshold at the threshold elevation, and extends to the decision height (DH) point. See paragraph 935. The following formula may be used * to compute the ROC in this zone:

$$ROC = D(\tan GS\angle) - \frac{D(t)}{S(i)}$$

CROSS SECTION

ANTENNA.

RUNWAYS WITH ZERO SLOPE



TCH = (TAN GS) (DIST ANT TO TH) - (TH ELEV-ANT ELEV)

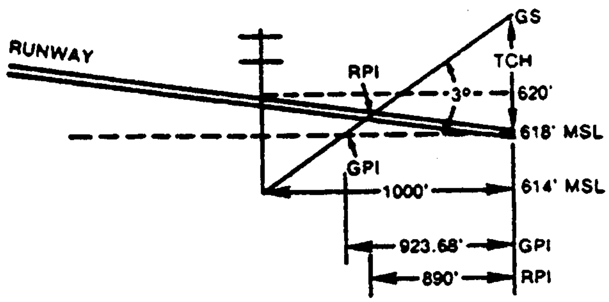
TCH = (.05241) (1000) - (618-614) = 48.41'

GPI = TCH ÷ TAN GS

GPI = 48.41 ÷ .05241 = 923.68'

RPI = GPI

POSITIVE SLOPING RUNWAYS



TCH = (TAN GS) (DIST ANT TO TH) - (TH ELEV-ANT ELEV)

TCH = (.05241) (1000) - (618-614) = 48.41'

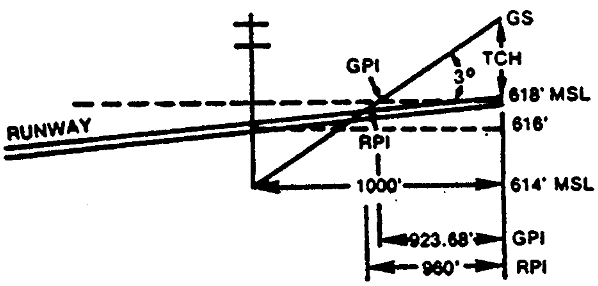
GPI = TCH ÷ TAN GS

GPI = 48.41 ÷ .05241 = 923.68'

$$\text{RPI} = \frac{\text{(TCH) (DIST ANT FROM TH)}}{\text{TCH + (RWY CROWN ELEV ABEAM ANT - ANT ELEV)}}$$

$$\text{RPI} = \frac{(48.41)(1000)}{48.41 + (620\text{-}614)} = 890'$$

NEGATIVE SLOPING RUNWAYS



TCH = (TAN GS) (DIST ANT TO TH) - (TH ELEV - ANT ELEV)

TCH = (.05241) (1000) - (618-614) = 48.41'

GPI = TCH ÷ TAN GS

GPI = 48.41 ÷ .05241 = 923.68'

$$\text{RPI} = \frac{\text{(TCH) (DIST ANT FROM TH)}}{\text{TCH + (RWY CROWN ELEV ABEAM ANT - ANT ELEV)}}$$

$$\text{RPI} = \frac{(48.41)(1000)}{48.41 + (616\text{-}614)} = 960'$$

Figure 129. RPI/GPI/TCH COMPUTATIONS FOR ILS WITH RAPIDLY DROPPING TERRAIN. Par 10, Appendix 2.

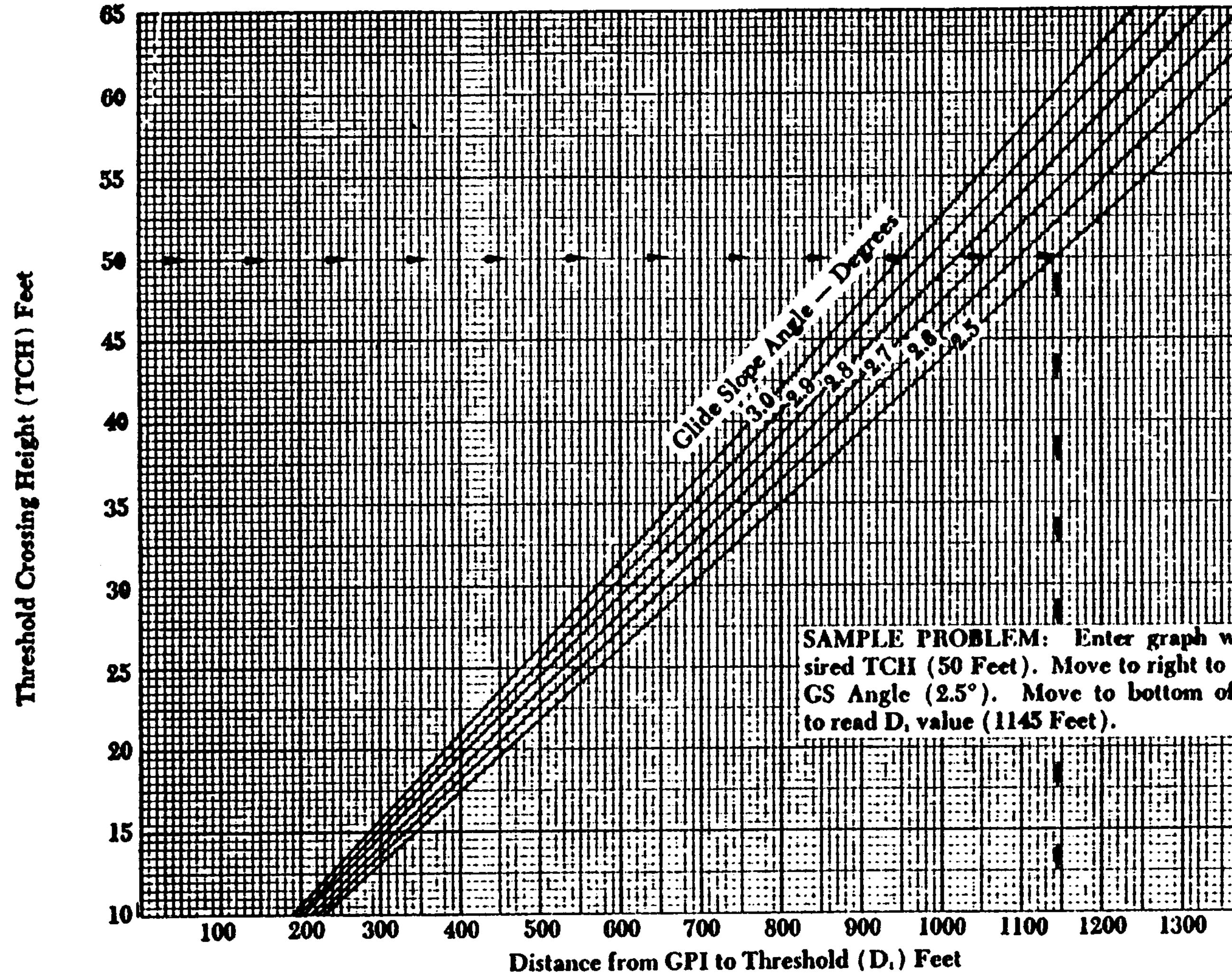


Figure 130. RELATIONSHIP OF GS ANGLE, TCH, AND DISTANCE FROM GPI. Par 10, Appendix 2.

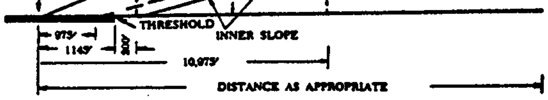


Figure 131. FINAL APPROACH AREA SEGMENTS. Par 11, Appendix 2 *

NOTE: The formula is equal to the separation of the glide slope and the associated slope of the approach surface inner section. See paragraph 931 and figure 132.

* (2) **Zone 2.** This zone starts at the DH, and extends outward to a point 10,975 feet from the GPI. See parapgraph 934. The following formula may be used to compute the ROC in this zone: *

ROC=.02366D+20 feet.

NOTE: The Zone 2 ROC formula is approximately equal to the separation of the glide slope and the associated slope of the approach surface inner section. See paragraph 931 and table 19.

(3) **Zone 3.** This zone starts at a point 10,975 feet outward from the GPI and extends outward to a maximum distance of 15 miles or to a point where the glide slope interception occurs, whichever is the lesser. See paragraph 934 and figure 76. The following formula may be used to compute the ROC in this zone:

ROC=.01866D+75 feet.

NOTE: The Zone 3 ROC formula is approximately equal to the separation of the glide slope and the associated slope of the approach surface outer section. See paragraph 931 and table 19.

12. ANALYSIS OF OBSTACLE CLEARANCE.

a. Problem. Runway threshold elevation is 342 feet MSL. Obstacles in the approach area are:

Zone 1: 22 feet above threshold & 1200 feet from threshold.

Zone 2: 228 feet above threshold & 8000 feet

(1) Desired GS angle = 2.5 degrees.

(2) Desired TCH = 50 feet.

c. Obstacle Clearance Criteria Application. See figure 133.

$$D_1 = \frac{TCH}{\tan GS\angle}$$

$$= \frac{50}{.04366}$$

$$= \underline{1145 \text{ feet}}$$

or see figures 129 and 129a.

(2) Zone 1 ROC.

D = 1145 + 1200 = 2345 feet.

D(t) = 1200 - 200 = 1000 feet.

S(i) = 50 (See figure 132. 50:1 = 50, 40:1 = 40)

$$ROC = D(\tan GS\angle) - \frac{D(t)}{S(i)}$$

$$= 2345x.04366 - \frac{1000}{50}$$

= 102 - 20

= <u>82 feet.</u>

Actual Clearance

"C" = D(tan GS angle) - Obstacle height.

= (2345 x .04366) - 22

= 102 - 22 = 80 feet. (Note Violation)

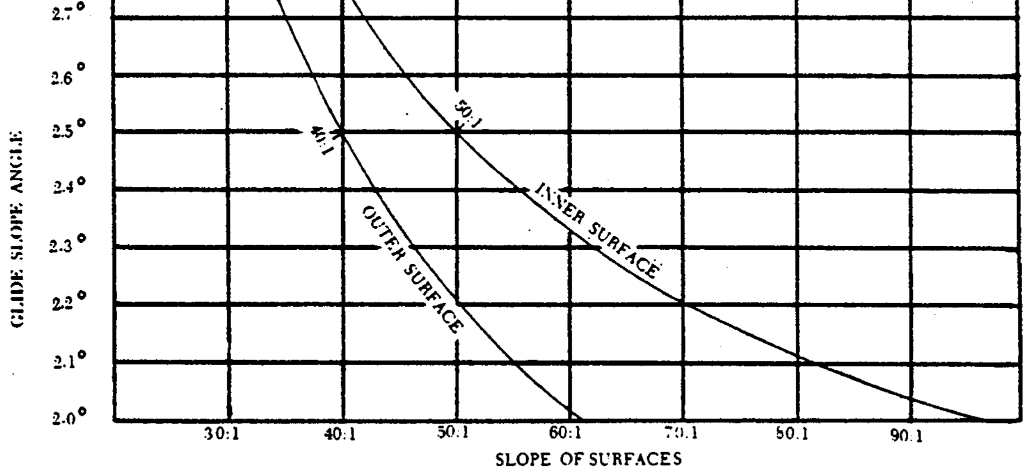


Figure 132. GS ANGLE VS. SLOPE OF SURFACES. Par 931, 1021, and App 2, Par 11.

(3) Zone 2 ROC.

D = 1145 + 8000 = 9145 feet.

ROC = .02366D + 20

= (.02366 x 9145) + 20

= 216 + 20 = 236 feet.

Actual Clearance

"C" = D (tan GS angle) - Obstacle height

= (9145 x .04366) - 228

= 399 - 228 = 171 feet. (Note Violation)

(4) Zone 3 ROC.

D = 1145 + 20,000 = 21,145 feet.

ROC = .01866D + 75

= (.01866 x 21,145) + 75

= 395 + 75 = 470 feet.

Actual Clearance

"C" = D (tan GS angle) - Obstacle height

= (21,145 x .04366) - 450

= 923 - 450 = 473 feet.

d. Analysis. It is noted that violations to ROC criteria exist in Zones 1 and 2.

(1) Zone 1. Violation could be corrected by:

(a) Raising the GS angle.

$$S(i) = \frac{D(t)}{\text{Obstacle height}}$$

$$= \frac{1000}{22}$$

= 45.5 (or 45.5:1)

Minimum angle from Figure 132 = 2.62 degrees.

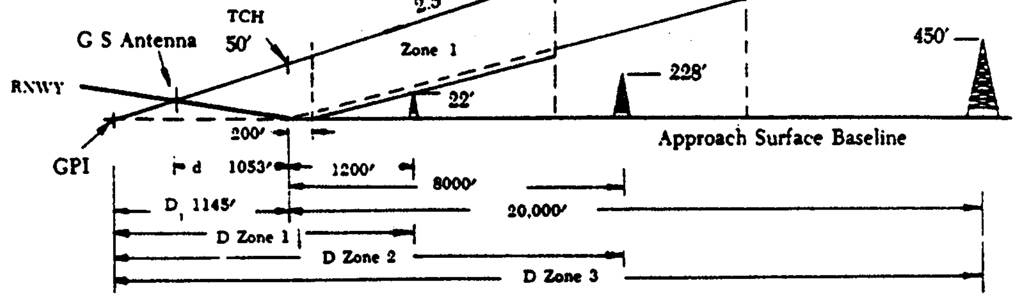


Figure 133. APPLICATION OF OBSTACLE CLEARANCE CRITERIA. App 2, Par 12. *

(b) Or; by retaining the 2.5 degree GS angle and displacing the threshold.

Minimum D(t) = S(i) (D tan GS angle - Actual Clearance)

= (50) x (2345 x .04366) - 80

= 50 x (102-80)

= 50 x 22 = <u>1100 feet.</u> <u>Requires displacement of threshold 100 feet.</u>

(2) **Zone 2.** Violation could be corrected by:

(a) Raising the GS angle.

$$\text{Minimum GS angle (arc tan)} = \frac{\text{ROC + Obstacle height}}{\text{D}}$$

$$= \frac{236 + 228}{9145}$$

= .05074 (arc tan)

Table of tangents shows the angle for .05074 to be <u>2.91 degrees.</u>

(b) Or; by retaining the 2.5 degree glide slope and increasing the distance D_1 between the GPI and the runway threshold. To do this, we must first determine the correct D based upon obstacle height and the ROC at the new D:

$$\text{D (in Zone 2)} = \frac{\text{Obstacle Height + 20}}{.02}$$

$$= \frac{228 + 20}{.02} = 12{,}400'$$

Since the new D_1 is greater than 10,975', this movement of the GS would cause the obstacle to fall in Zone 3. Therefore, further analysis would require Zone 3 treatment.

$$\text{D (in Zone 3)} = \frac{\text{Obstacle Height + 75}}{.025}$$

$$= \frac{228 + 75}{.025} = \frac{303}{.025}$$

D = 12120'

Minimum D_1 = D-8000

= 12120-8000

= 4120 feet

It should be noted that once the GPI is changed a recalculation of all ROC's must be performed and a new sketch made.

Please submit any written comments or recommendations for improving this directive, or suggest new items or subjects to be added to it. Also, if you find an error, please tell us about it.

Subject: Order 8260.3B

To: Directives Management Officer, AVN-12

(Please check all appropriate line items)

- O An error (procedural or typographical) has been noted in paragraph _______ on page _______.

- O Recommend paragraph _______ on page _______ be changed as follows:
(attach separate sheet if necessary)

- O In a future change to this directive, please include coverage on the following subject
(briefly describe what you want added):

- O Other comments:

- O I would like to discuss the above. Please contact me.

Submitted by:________________________ Date:________________

FTS Telephone Number: ______________ Routing Symbol: ________________

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